DOI: https://doi.org/10.61841/ezqcqp43 Publication URL: https://nnpub.org/index.php/MHS/article/view/2113

EFFECT OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS) ON THE PATIENTS WITH CHRONIC LOW BACK PAIN : SYSTEMATIC REVIEW

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ABSTRACT

Background: *The ailment known as low back pain (LBP) is quite common and intricate. It is frequently advised that people receive pharmaceutical therapy in order to reduce the burden of LBP on their everyday life*

Aims : *This systematic review is to review the effect and efficacy of transcutaneous electrical nerve stimulation in the treatment of chronic low back pain.*

Methods: *By comparing itself to the standards set by the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020, this study was able to show that it met all of the requirements. So, the experts were able to make sure that the study was as up-to-date as it was possible to be. For this search approach, publications that came out between 2014 and 2024 were taken into account. Several different online reference sources, like Pubmed, ScienceDirect and SagePub, were used to do this. It was decided not to take into account review pieces, works that had already been published, or works that were only half done.*

Result: *In the PubMed database, the results of our search brought up 240 articles, whereas the results of our search on SAGEPUB brought up 1.683 articles, our search on SCIENCE DIRECT brought up 1.647 articles. The results of the search conducted for the last year of 2014 yielded a total 124 articles for PubMed, 610 articles for SAGEPUB and 429 articles for SCIENCE DIRECT. In the end, we compiled a total of 7 papers, 4 of which came from PubMed, 1 of which came from SAGEPUB and 2 of which came from SCIENCE DIRECT. We included seven research that met the criteria.*

Conclusion: *In summary, although the use of transcutaneous electrical nerve stimulation (TENS) still controversial in medical to treat low back pain, the studies mostly showed that TENS can reduce the pain of chronic low back pain (CLBP), and also can decreased the function of the back.*

Keyword: *Transcutaneous electrical nerve stimulation, chronic low back pain*

INTRODUCTION

Physical activity, trauma, and inflammatory diseases can all contribute to the crippling syndrome known as chronic low back pain. According to research on the Global Burden of Disease, chronic back pain (CBP) ranks sixth in terms of life years with a disability and first in terms of years lived with a handicap. Age-related increases in the rate of CBP are to be predicted. Surprisingly, new research has discovered a correlation between CBP and depression, body fat index, and smoking. Effective treatment of this illness is becoming more and more crucial as the global population ages and gains weight.[1,2]

Although pharmaceutical therapy is commonly used to address individuals with CBP, many patients abandon treatment due to lack of effectiveness and unpleasant effects. Nonpharmacological methods like physical therapy and exercise could be helpful for these people. CBP has also been treated using nerve stimulation treatment (NST), which modifies the activity of the central and peripheral nervous system components. Electroacupuncture (EA) is one of the first NSTs and has been utilized for pain management for many years. In order to maximize pain relief, needles are placed into the skin, soft tissue, or muscles to administer neural stimulation with EA. As its names suggest, percutaneous electrical nerve stimulation (PENS) and percutaneous neuromodulation treatment (PNT) similarly include skin-piercing needles or electrodes. Transcutaneous electrical nerve stimulation is an additional method that has been licensed to treat chronic pain (TENS). While TENS and percutaneous methods provide comparable neuromodulation, TENS is applied via the skin using surface electrodes enclosed in a patch.[3]

TENS is a low-cost therapeutic technique that uses electrical impulses to penetrate the skin. TENS is generally not advised for use in the treatment of CLBP because to the inconsistent data supporting its therapeutic benefits.[3] On the other hand, new clinical research has improved our knowledge of TENS. TENS reduces hyperalgesia by activating descending inhibitory systems through a complicated neural network.[4] There is mounting evidence that central pain systems that are sensitized can account for the change from acute to chronic lower back pain. Recently, a subset of individuals with CLBP was shown to have symptoms of central sensitization (CS). Many studies have previously shown that chronic pain disorders, including CLBP, are associated with broad hyperalgesia and severe disruption in the descending inhibitory pathways.[5]

Changes in descending anti-nociceptive mechanisms, increased activity in pain facilitatory pathways, and temporal accumulation of second pain or wind-up are the components of chronic somatosensory overload (CS). It is crucial to remember that CS is a neurophysiological idea and that therapeutic therapy cannot directly test the underlying mechanisms. Patients with LBP who have persistent CS have worse treatment outcomes and a lower quality of life. Determining if CS is present is crucial not just from a clinical perspective but also for the purpose of creating customized and suitable therapies. Quantitative sensory testing is used to investigate altered sensory processing, including indications of CS. Research on fibromyalgia patients shows reduced pressure pain thresholds (PPT) and restored central pain modulation (CPM).[5,6]

Though research on TENS's impact on PPTs in CLBP patients has been done, there doesn't appear to be much data on how well it works for CPM. Moreover, research using TENS provide encouraging outcomes for pain management in movement-evoked pain (MEP). MEP is the term used to describe pain that arises from physical exertion. Study results indicate that MEP and resting pain (also known as spontaneous pain) are probably caused by distinct underlying processes, hence it makes sense to evaluate both as potential therapy outcomes.[7]

METHODS

Protocol

The author of this study ensured that it complied with the standards by adhering to Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 guidelines. This is done to guarantee the accuracy of the results that are derived from the investigation.

Criteria for Eligibility

In order to complete this literature evaluation, we looked at published research that discusses the effect and efficacy of transcutaneous electrical nerve stimulation in the treatment of chronic low back pain. This is done to enhance the patient's therapy management and to offer an explanation. This paper's primary goal is to demonstrate the applicability of the issues that have been noted overall.

To be eligible to participate in the study, researchers had to meet the following requirements: 1) English must be used to write the paper. The manuscript must fulfill both of these conditions in order to be considered for publication. 2) A few of the examined studies were released after 2013 but prior to the time frame considered relevant by this systematic review. Editorials, submissions without a DOI, already published review articles, and entries that are nearly exact replicas of journal papers that have already been published are a few examples of research that are prohibited.

Search Strategy

We used "transcutaneous electric nerve stimulation", and "chronic low back pain" as keywords.The search for studies to be included in the systematic review was carried out using the PubMed and SAGEPUB databases by inputting the words: ("transcutaneous electric nerve stimulation"[MeSH Terms] OR ("transcutaneous"[All Fields] AND "electric"[All Fields] AND "nerve"[All Fields] AND "stimulation"[All Fields]) OR "transcutaneous electric nerve stimulation"[All Fields] OR ("transcutaneous"[All Fields] AND "electrical"[All Fields] AND "nerve"[All Fields] AND "stimulation"[All Fields]) OR "transcutaneous electrical nerve stimulation"[All Fields]) AND (("chronic"[All Fields] OR "chronical"[All Fields] OR "chronically"[All Fields] OR "chronicities"[All Fields] OR "chronicity"[All Fields] OR "chronicization"[All Fields] OR "chronics"[All Fields]) AND ("low back pain"[MeSH Terms] OR ("low"[All Fields] AND "back"[All Fields] AND "pain"[All Fields]) OR "low back pain"[All Fields])) used in searching the literature.

Data retrieval

After reading the abstract and the title of each study, the writers performed an examination to determine whether or not the study satisfied the inclusion criteria. The writers then decided which previous research they wanted to utilise as sources for their article and selected those studies. After looking at a number of different research, which all seemed to point to the same trend, this conclusion was drawn. All submissions need to be written in English and can't have been seen anywhere else.

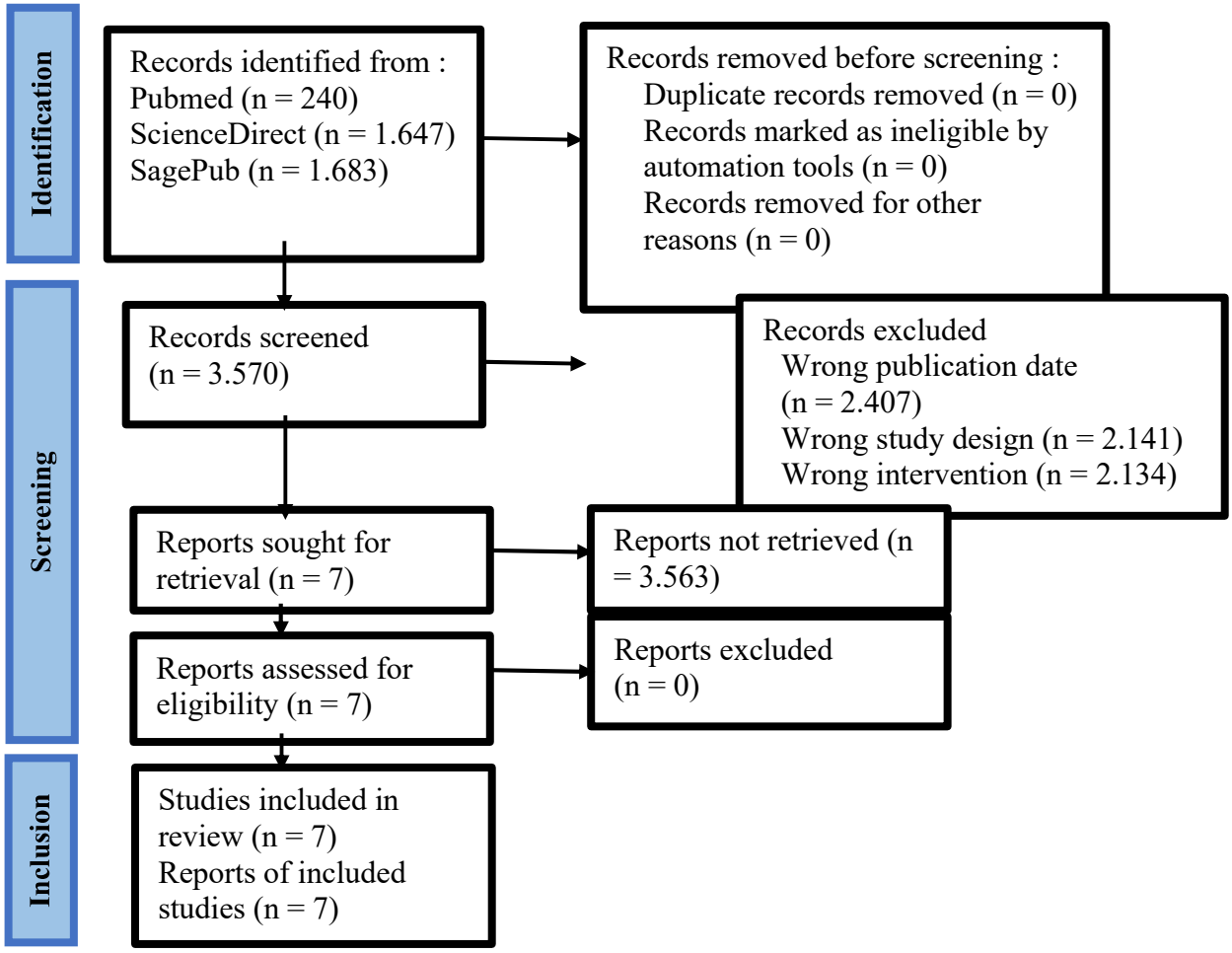

Figure 1. Prisma Flow Diagram

Only those papers that were able to satisfy all of the inclusion criteria were taken into consideration for the systematic review. This reduces the number of results to only those that are pertinent to the search. We do not take into consideration the conclusions of any study that does not satisfy our requirements. After this, the findings of the research will be analysed in great detail. The following pieces of information were uncovered as a result of the inquiry that was carried out for the purpose of this study: names, authors, publication dates, location, study activities, and parameters.

Quality Assessment and Data Synthesis

Each author did their own study on the research that was included in the publication's title and abstract before making a decision about which publications to explore further. The next step will be to evaluate all of the articles that are suitable for inclusion in the review because they match the criteria set forth for that purpose in the review. After that, we'll determine which articles to include in the review depending on the findings that we've uncovered. This criteria is utilised

in the process of selecting papers for further assessment. in order to simplify the process as much as feasible when selecting papers to evaluate. Which earlier investigations were carried out, and what elements of those studies made it appropriate to include them in the review, are being discussed here.

RESULT

In the PubMed database, the results of our search brought up 240 articles, whereas the results of our search on SAGEPUB brought up 1.683 articles, our search on SCIENCE DIRECT brought up 1.647 articles. The results of the search conducted for the last year of 2014 yielded a total 124 articles for PubMed, 610 articles for SAGEPUB and 429 articles for SCIENCE DIRECT. In the end, we compiled a total of 7 papers, 4 of which came from PubMed, 1 of which came from SAGEPUB and 2 of which came from SCIENCE DIRECT. We included seven research that met the criteria.

Lemans, et al[8] (2021) showed that patients with chronic low back pain (CLBP) do not appear to have a decrease in pain levels when using TENS and heat together. PPT values dramatically increased, demonstrating the beneficial effects of the experimental intervention. The combination of heat and TENS promotes normal central pain processing, but it has no effect on the normalization of pain inhibitory function. This suggests that the therapy activates local analgesic effects rather than brain-orchestrated ones. Increased PPT, however, is consistent with this theory. TS and CPM remain constant.

Jalalvandi, et al[9] (2022) showed that after 18 intervention sessions, both groups had less pain and impairment. However, compared to the back exercise group, the TENS group saw a higher degree of improvement in pain and impairment.

Ezema, et al[10] (2022) showed that pain intensity was considerably decreased by transcutaneous electrical nerve stimulation (TENS) up to 24 hours after treatment.

Table 1. The litelature include in this study

Author	Origin	Method	Sample	Result
Leemans et al, 2021[8]	Belgium	Randomized controlled clinical study	50 patients	This research had fifty participants. Only the experimental group had significantly increased pressure pain threshold measurements for the lower back and second plantar toe after 30 minutes and 4 weeks.
Jalalvandi et al, 2022[9]	Iran	Randomized clinical study	46 patients	When the baseline values were taken into account, the TENS group's pain score decrease was substantially larger than that of the back exercises group (mean difference (95% CI): -4.23 (-8.03 to -0.44); P-value = 0.030; Cohen's d = 0.81). Furthermore, compared to back workouts, TENS significantly reduced the disability ratings (mean difference (95% CI): −3.99 (−7.35 to −0.64); P-value = 0.021; Cohen's d = 0.73). Additionally, it was shown that the interaction between time and group had a statistically significant influence on the pain and disability score (interaction p<0.001).
Ezema et al, 2022[10]	Nigeria	Randomized controlled study	62 patients	The TENS group experienced improved pain alleviation; there was a significant temporal difference in PI across groups, F (1, 58) = 18.83, p< 0.001. After the intervention, TENS had a relative analgesic effect that

				began immediately (median difference [M×D] = -3, p< 0.001), peaked at one hour (M×D = -4, p< 0.001), and faded out after twenty-four hours (M×D = -1, p = 0.029). Nevertheless, from 0 to 24 hours after the treatments, there was no significant difference in βE and ME across the groups, and there was also no significant link between the PI and either βE or ME.
Tella et al, 2022[11]	Nigeria	Randomized clinical study	33 patients	After the three therapies, pain intensity was considerably ($p < 0.05$) decreased, while tactile acuity was significantly ($p < 0.05$) enhanced following the TENS intervention alone. The individuals' tactile acuity scores did not alter based on their gender, according to the results. TENS improves tactile acuity in those with NSCLBP, but IFC showed no discernible improvement in tactile acuity.
Garaud et al, 2018[12]	France	Randomized study	97 patients	At the end-of-study visit, 22 patients remained assessable, while 33 patients in the TENS-TEP group were assessed at the same time. The Dallas score and the EIFEL score (P =.50 and P =.18, respectively) showed a comparable variation over time between groups. The groups did not vary significantly in terms of movement pain scores (P =.52 for back pain and P =.56 for leg pain) or resting pain scores (P =.94 for back pain and P =.16 for leg pain). Regarding analgesics and social influence, there was no significant difference between the groups at month six (P =.85). During the trial, two patients (one from each group) experienced a significant adverse event that could not be linked to the therapy under investigation.
Schwarm et al, 2021[13]	Germany	Retrospective randomized study	41 patients	The 41 patients in the group had a median age of 60.5 years (IQR25-75 52–67), with 19 females and 22 males. A pair of patients were not followed up on. Fifteen patients who showed a favorable TENS effect and fifteen who did not were implanted with a pulse generator (IPG) following

				positive PNFS testing. Nine individuals had their leads removed following a negative PNFS testing phase. TENS responders will also respond to PNFS, as evidenced by the substantial association that TENS positive patients displayed to a positive impact in the NRS reduction phase of the PNFS experiment ($p = 0.042$; 94% of patients). The median NRS and SF12v2 (PCS) after three and six months of follow-up showed substantial improvements in both groups; however, SF12v2 (MCS) and ODI showed significant improvement only in the TENS positive cohort.
Schwarm et al, 2019[14]	Germany	Retrospective randomized study	25 patients	In 14 individuals, there was no discernible pain alleviation. Ten of these individuals later shown favorable results in the stimulation of the PNFS study. TENS provided pain alleviation in four of the patients. Three patients achieved adequate pain reduction during the PNFS experiment, whereas one patient later showed no effect. Five patients in the entire cohort did not benefit from the PNFS study, and 20 patients had neurostimulators implanted. After six months, there was a persistent decline in the need for analgesics in 55% of cases, and after twelve months, in 50% of cases. When choosing patients with low back pain for PNFS therapy, TENS has little prognostic value. A unique determination of the medical indication for PNFS therapy in cases of low back pain is required.

Tella, et al[11] (2022) showed that transcutaneous electrical nerve stimulation (TENS) improves tactile acuity in those with nonspecific chronic low back pain (NSCLBP).

Garaud, et al[12] (2018) showed that after treatment with TENS, patients may have had a greater rate of early withdrawals because some individuals with symptoms that did not improve had withdrew early.

Schwarm, et al[13] (2021) showed that given that TENS-positive patients had a strong link with a favorable PNFS trial period, TENS can be used to predict patient selection in PNFS. Consequently, it may be appropriate to directly implant leads and IPG in TENS positive individuals. Patients who test positive for TENS also often exhibit improved follow-up results.

Schwarm, et al[14] (2019) showed that when choosing patients with low back pain for PFNS therapy, TENS has little prognostic value. Peripheral nerve field stimulation (PNFS) dramatically reduces the symptoms of persistent low back pain in a safe and effective manner.

DISCUSSION

This systematic review involved a total of 354 data of patients with chronic low back pain that treated with transcutaneous electrical nerve stimulation (TENS).

The ailment known as low back pain (LBP) is quite common and intricate. There are substantial socioeconomic consequences linked to it. It is frequently advised that people receive pharmaceutical therapy in order to reduce the burden of LBP on their everyday life. But prescription drugs in an unsuitable or suboptimal way is a regular practice. Nonpharmacological therapy for these individuals, such transcutaneous electrical nerve stimulation (TENS), may be beneficial.[15]

TENS is a low-cost therapeutic technique that uses electrical impulses to penetrate the skin. TENS is generally not advised for use in the treatment of chronic low back pain (CLBP) because to the inconsistent data supporting its therapeutic benefits. On the other hand, new clinical research has improved our knowledge of TENS. TENS reduces hyperalgesia by activating descending inhibitory systems through a complicated neural network.[3,4]

Even it seems controversial, Ezema in their study to determine the efficacy of TENS in the treatment of CLBP showed that TENS significantly reduced the pain intensity of the patients up to 24 hours post treatment. They did the double blind trial in 62 patients that randomized into TENS group (frequency 100 Hz, burst-rate 2 Hz, burst-width 150 μs, intensity 40 mA, duration 30 min), and sham-TENS group. The TENS group experienced improved pain alleviation; there was a significant temporal difference in PI across groups, $F(1, 58) = 18.83$, $p < 0.001$. After the intervention, TENS had a relative analgesic effect that began immediately (median difference [MD] = -3, $p < 0.001$), peaked at one hour (MD = -4, $p < 0.001$), and faded out after twenty-four hours (MD = -1, $p = 0.029$).[10]

Leemans, et al also did study by combining TENS with heat to reduce pain in CLBP with 50 patients with CLBP that randomly assign into two groups. They showed the results that patients with CLBP do not appear to have a decrease in pain levels when using TENS and heat together. PPT values dramatically increased, demonstrating the beneficial effects of the experimental intervention. The combination of heat and TENS promotes normal central pain processing, but it has no effect on the normalization of pain inhibitory function. This suggests that the therapy activates local analgesic effects rather than brain-orchestrated ones. Increased PPT, however, is consistent with this theory. TS and CPM remain constant.

Jalalvandi, et al also studied about the effects of TENS in 30 women, 14 men with the mean age is 37.86 ± 6.74. The TENS group saw a considerably larger reduction in pain score than the back exercises group after correcting for baseline values. Furthermore, compared to back workouts, TENS significantly reduced the disability ratings (mean difference (95% CI): −3.99 (−7.35 to −0.64); P-value = 0.021; Cohen's d = 0.73). Additionally, it was shown that the interaction between time and group had a statistically significant influence on the pain and disability score (interaction $p<0.001$). The results showed that after 18 intervention sessions, both groups had less pain and impairment. However, compared to the back exercise group, the TENS group saw higher improvements in pain and impairment.[9]

The effects of TENS also studied by Tella, et al with 33 individuals with CLBP and randomly devided into three groups of study. After the three therapies, pain intensity was considerably ($p < 0.05$) decreased, while tactile acuity was significantly ($p < 0.05$) enhanced following the TENS intervention alone. The individuals' tactile acuity scores did not alter based on their gender, according to the results.[11]

Different with other studies, Garaud, et al showed even in cases when patients benefitted from a therapeutic education program run by a pain resource nurse, the overall findings of this study do not support the use of TENS in the treatment of patients with chronic LBP. The high number of early withdrawals in both groups, but especially in the TENS group, implies that more patients in this group who experienced symptom increases left the group early. This could skew the picture of the between-group lack of difference and raise concerns about the generalizability of the findings.[12]

According to the study by Schwarm, et al, patients with persistent low back pain might benefit from an alternate therapy option called peripheral nerve field stimulation (PNFS). In pain treatment, transcutaneous electrical nerve stimulation (TENS) is widely utilized. In their study with 41 patients (19 females and 22 males) with the median age of 60.5 years. TENS responders will also respond to PNFS, as evidenced by the substantial association that TENS positive patients displayed to a positive impact in the NRS reduction phase of the PNFS experiment ($p = 0.042$; 94% of patients).[14]

Schwarm, et al two years later in their studies showed that when choosing patients with low back pain for PFNS therapy, TENS has little prognostic value. PNFS dramatically reduces the symptoms of persistent low back pain in a safe and effective manner.[13]

CONCLUSION

In summary, although the use of transcutaneous electrical nerve stimulation (TENS) still controversial in medical to treat low back pain, the studies mostly showed that TENS can reduce the pain of chronic low back pain (CLBP), and also can decreased the function of the back.

REFERENCE

[1] Vos T, Barber RM, Bell B, Bertozzi-Villa A, Biryukov S, Bolliger I, et al. Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990-2013: A systematic analysis for the Global Burden of Disease Study 2013. The Lancet. 2015 Aug 22;386(9995):743–800.

[2] Suri P, Boyko EJ, Smith NL, Jarvik JG, Williams FMK, Jarvik GP, et al. Modifiable risk factors for chronic back pain: insights using the co-twin control design. Spine Journal. 2017 Jan 1;17(1):4–14.

[3] Wu LC, Weng PW, Chen CH, Huang YY, Tsuang YH, Chiang CJ. Literature Review and Meta-Analysis of Transcutaneous Electrical Nerve Stimulation in Treating Chronic Back Pain. Reg Anesth Pain Med. 2018 May 1;43(4):425–33.

[4] Sluka KA, Bjordal JM, Marchand S, Rakel BA. What makes transcutaneous electrical nerve stimulation work? Making sense of the mixed results in the clinical literature. Phys Ther. 2013 Oct;93(10):1397–402.

[5] Aoyagi K, He J, Nicol AL, Clauw DJ, Kluding PM, Jernigan S, et al. A Subgroup of Chronic Low Back Pain Patients with Central Sensitization. Clinical Journal of Pain. 2019;

[6] Corrêa JB, Costa LOP, de Oliveira NTB, Sluka KA, Liebano RE. Central sensitization and changes in conditioned pain modulation in people with chronic nonspecific low back pain: a case–control study. Exp Brain Res. 2015 Aug 25;233(8):2391–9.

[7] Dailey DL, Rakel BA, Vance CGT, Liebano RE, Amrit AS, Bush HM, et al. Transcutaneous electrical nerve stimulation reduces pain, fatigue and hyperalgesia while restoring central inhibition in primary fibromyalgia. Pain. 2013;154(11):2554–62.

[8] Leemans L, Elma Ö, Nijs J, Wideman TH, Siffain C, den Bandt H, et al. Transcutaneous electrical nerve stimulation and heat to reduce pain in a chronic low back pain population: a randomized controlled clinical trial. Braz J Phys Ther. 2021 Jan 1;25(1):86–96.

[9] Jalalvandi F, Ghasemi R, Mirzaei M, Shamsi MB. Effects of back exercises versus transcutaneous electric nerve stimulation on relief of pain and disability in operating room nurses with chronic non-specific LBP: a randomized clinical trial. BMC Musculoskelet Disord. 2022 Dec 1;23(1).

[10] Ezema CI, Onyeso OK, Nna EO, Awosoga OA, Odole AC, Kalu ME, et al. Transcutaneous electrical nerve stimulation effects on pain-intensity and endogenous opioids levels among chronic low-back pain patients: A randomised controlled trial. J Back Musculoskelet Rehabil. 2022;35(5):1053–64.

[11] Tella BA, Oghumu SN, Gbiri CAO. Efficacy of Transcutaneous Electrical Nerve Stimulation and Interferential Current on Tactile Acuity of Individuals With Nonspecific Chronic Low Back Pain. Neuromodulation. 2022;25(8):1403–9.

[12] Garaud T, Gervais C, Szekely B, Michel-Cherqui M, Dreyfus JF, Fischler M. Randomized study of the impact of a therapeutic education program on patients suffering from chronic low-back pain who are treated with transcutaneous electrical nerve stimulation. Medicine (United States). 2018 Dec 1;97(52).

[13] Schwarm FP, Ott M, Nagl J, Bender M, Stein M, Uhl E, et al. The Predictive Value of Transcutaneous Electrical Nerve Stimulation for Patient Selection in Peripheral Nerve Field Stimulation for Chronic Low Back Pain: A Prospective Study. Neuromodulation: Technology at the Neural Interface. 2021;24(6):1051–8.

[14] Schwarm FP, Stein M, Uhl E, Maxeiner H, Kolodziej MA. A Retrospective Analysis of 25 Cases With Peripheral Nerve Field Stimulation for Chronic Low Back Pain and the Predictive Value of Transcutaneous Electrical Nerve Stimulation for Patient Selection. Neuromodulation: Technology at the Neural Inteface. 2019;22(5):607–14.

[15] Hartvigsen J, Hancock MJ, Kongsted A, Louw Q, Ferreira ML, Genevay S. What low back pain is and why we need to pay attention. Lancet2018. 2018;391(10137):2356–67.